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of the subject. The reader who wishes to carry his studies further will find ample assistance in Thomson and Tait, in Rayleigh's *Theory of Sound*, and in Whittaker's *Analytical Dynamics*. And in common with other recent writers I must mention with a special sense of obligation the works of Routh, which in their later forms are an almost inexhaustible storehouse of theorems and results, and abound in interesting historical references."

Contents—Chapter I: Kinematics of a rigid body. Finite displacements, 1-13; II: Infinitesimal displacements, 14-33; III: Statics, 34-65; IV: Moments of inertia, 66-73; V: Instantaneous motion of a body (kinematics), 74-88; VI: Dynamical equations, 89-111; VII: Free rotation of a rigid body, 112-128; VIII: Gyrostatic problems, 129-150; IX: Moving axes, 151-176; X: Generalized equations of motion, 177-207; XI: Theory of vibrations, 208-248; XII: Variational methods, 249-270; Index, 271-272.

ARTICLES IN CURRENT PERIODICALS.

AMERICAN JOURNAL OF SCIENCE, fifth series, volume 2, September, 1921: "Some mechanical curiosities connected with the earth's field of force" by W. D. Lambert,¹ 129-158 [List of mechanical curiosities: (1) The limiting level surface with the sharp edge. (2) The smooth lake with different elevations for its two ends. (3) The tendency of large bodies to 'fall' towards the equator. (4) The tendency of a rod suspended horizontally like the Eötvös balance to 'fall' by twisting about the supporting fiber. (5) The existence of great local irregularities in the curvature of the level surfaces and the interesting possibilities that the study of these irregularities seems likely to offer. "]

ANNALES SCIENTIFIQUES DE L'ECOLE NORMALE SUPÉRIEURE, third series, volume 38, August to December, 1921: "Problèmes d'hydrodynamiques relatifs aux mouvements glissants" by R. Thiry, 229-339; "Sur les ensembles abstraits" by M. Fréchet, 341-388; "Recherches sur le théorème de M. Picard" by G. Valiron, 389-429; "Rectification et complément au mémoire de la goutte liquide tournante" by J. Boussinesq, 431-437 (see 1922, 20).

BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY, volume 27, June-July, 1921: "The April meeting of the American Mathematical Society" by R. G. D. Richardson, 389-400; "The Easter meeting of the Society at Chicago" by A. Dresden, 401-410; "The April meeting of the San Francisco Section" by B. A. Bernstein, 411-414; "The general theory of approximation by polynomials and trigonometric sums" by D. Jackson, 415-431; "The Einstein solar field" by L. P. Eisenhart, 432-434; "A covariant of three circles" by A. B. Coble, 434-437; "On skew parabolas" by Mary F. Curtis, 437-438; "The dispersion of observations" by J. L. Coolidge, 439-442; "The isomorphisms of complex algebra" by N. Wiener, 443-445; "On the generalization of certain fundamental formulas of the mathematical theory of finance" by C. H. Forsyth, 446-452; "The spread of Newtonian and Leibnizian notations of the calculus" by F. Cajori, 453-458; "Group theory reviews in the *Jahrbuch über die Fortschritte der Mathematik*" by G. A. Miller, 459-462; "Recent books on vector analysis" by J. B. Shaw, 463-465 [reviews of R. Gans's *Einführung in die Vektoranalysis, mit Anwendungen auf die mathematische Physik*, fourth edition (Leipzig and Berlin, 1921), of L. Silberstein's *Elements of Vector Algebra* (New York, 1919), of C. Runge's *Vektoranalysis*. Vol. I. *Die Vektoranalysis des dreidimensionalen Raumes* (Leipzig, 1919), of R. Leveugle's *Précis de Calcul géométrique* (Paris, 1920)]; Reviews by R. D. Carmichael of *Œuvres de G. H. Halphen* (2 vols., Paris, 1916-1918), 466-468, of G. H. Hardy's *Some famous problems of the theory of numbers and in particular Waring's problem* (Oxford, 1920), 471-475, and of O. Stolz and J. A. Gmeiner's *Theoretische Arithmetik* (2d ed., 2 vols., Leipzig, 1911-1915), 485; Reviews by D. E. Smith of F. Cajori's *A History of the Conceptions of Limits and Fluxions in Great Britain from Newton to Woodhouse* (Chicago, 1919), 468-470, of P. Kirchberger's *Mathematische Streifzüge durch die Geschichte der Astronomie* (Leipzig, 1921), 479-480, and of Emma Gifford's *Natural Tangents* (Manchester, England, 1920), 480; Review by J. B. Shaw of H. Lacaze's *Cours de Cinématique Théorique* (Paris, 1920), 470; Reviews by E. B. Wilson of H. Lamb's *Statics, including Hydrostatics and the Elements of the Theory of Elasticity* (Cambridge, 1916), 475-477, and of J. R. Eccles's *Advanced Lecture Notes on Light* (Cambridge, 1919), 485-486; Reviews by C. L. E. Moore of M. d'Ocagne's *Principes usuels de Nomographie* . . . (Paris, 1920),

¹ On page 141 he shows that a rod suspended horizontally (Eötvös torsion balance of the first kind) will tend to point east and west because the meridian sections of level surfaces in the earth's field of force are more curved than prime vertical surfaces. This tendency would seem to more than balance the tendency to point north and south that is due directly to the centrifugal force according to the statement in *Nature* of October 20, page 240 (see 1922, 22).

477-478, and of K. P. Williams's *Dynamics of the Airplane* (New York, 1921), 483; Review by H. L. Rietz of *Oeuvres Complètes de Christiaan Huygens* (vol. 14, The Hague, 1920), 481-482; Review by J. W. Young of D. E. Smith's *The Sumario Compendioso of Brother Juan Diez: The Earliest Mathematical Work of the New World* (Boston, 1921), 484; Review by H. H. Mitchell of *Materialien für eine wissenschaftliche Biographie von Gauss*, Heft 8, *Zahlbegriff und Algebra bei Gauss* by A. Fraenkel (Leipzig, 1920), 486-487; Notes, 488-495; New publications, 496-499; Thirtieth annual list of papers, 500-507; Index of volume 27, 508-516.

L'EDUCATION MATHÉMATIQUE, volume 24, November 1, 1921: "La géométrie du compas" (fin.), 17-18.

ENGINEERING NEWS RECORD, volume 87, November 17, 1921: "Some weaknesses of aerial photo maps" by P. J. Barry, 828 ["The principles of astronomy, trigonometry, geometry, geodesy and perspective cannot be assigned to oblivion by merely pressing a button. It is not as easy as that."]—November 24: "Improving the terminology in mechanics" by J. H. Griffith, 865—December 1: "Triangulating under difficulties" by H. W. Bradstreet, 899-900.

JAHRESBERICHT DER DEUTSCHEN MATHEMATIKER-VEREINIGUNG, volume 30, nos. 1-4 (issued October, 1921): "Mathematik und räumliche Anschauung" by R. Baldus, 1-15 [Translated extract: The oldest definition of mathematics designated it as the theory of magnitudes. This definition is to be avoided (even if the notion of magnitude be made clear) because there are wide domains of mathematics which it fails to embrace. One need only mention analysis situs, the theory of aggregates, and projective geometry. Were one, as has been done more recently, to describe mathematics as the science of drawing logically necessary conclusions, then mathematics and logical thought would coincide; this definition extends beyond mathematics. . . . These (Euclid's 13 Books of Elements) even as works of art influenced the non-mathematician very strongly. "Euclid's *Elements* seems to me almost as beautiful as Homer's *Iliad*" said H. S. Chamberlain in his *Foundations of the Nineteenth Century*]; "Die Mathematik in der Schulreform" by W. Lietzmann, 59-68 [Section titles: 1. Grundschule; 2. Die bisherigen höheren Knabenschulen; 3. Die Ziele des mathematischen Unterrichts in den höheren Schulen; 4. Die deutsche Oberschule; 5. Die Aufbauschulen; 6. Das höhere Mädchenschulwesen; 7. Die Mittelschulen; 8. Die Gabelungstendenzen; 9. Die Lehrerbildungsfrage; 10. Fortbildungseinrichtungen.]—Supplement: "Mathematische Gesellschaft in Göttingen," 32 [November 23, 1920: "Runge, Amerikanische Arbeiten über Sternhaufen und die Milchstrasse"; February 21-22, 1921: "Hilbert, Eine neue Grundlegung des Zahlbegriffes."]; "Mathematisches Kränzchen in Prag," 32 [February 4, 1921: "Winternitz, Die Knoppsche Erzeugungsweise der Kurven von Peano, Osgood und v. Koch."]; "Einstein-Preis des Scientific American," 34 [See, 1921, 191]—Nos. 5-8 (issued November, 1921): "W. R. Hamiltons Bedeutung für die geometrische Optik" by G. Prange, 69-82 [An appreciation and exposition of the fundamental and extensive results in geometrical optics obtained by W. R. Hamilton nearly one hundred years ago, only particular parts of which are generally familiar, such as the Hamilton-Jacobi theory in analytical mechanics, Hamilton's formula in the theory of congruences of lines in differential geometry, and the discovery of conical refraction in physics]; "Zur projektiven Differentialgeometrie der Ebene" by L. Berwald, 110-121 [A study of the "accompanying triangle," with reference to E. J. Wilczynski, S. W. Reaves, and others]—Supplement: "Programm der Jahresversammlung in Jena" (September 18-24, 1921), 45-47 [three papers on postulational treatment: "Fraenkel, Über die Zermelosche Begründung der Mengenlehre"; "Bernays, Über die Hilbertsche Grundlegung der Arithmetik"; "Hertz, Über die Minimalzahl von Axiomen für ein System von Sätzen und den Begriff des idealen Elementes."]; "Preisaufgaben und gekrönte Preisschriften," 52 [reannouncement of Wolfskehl prize of 100,000 marks "für denjenigen . . . dem es zuerst gelingt, den Beweis des grossen Fermatschen Satzes zu führen."]

JOURNAL OF THE INDIAN MATHEMATICAL SOCIETY, volume 13, August, 1921: "On the cartesian oval" (second paper) by W. R. Aiyar, 121-132; "On the expansion of certain functions (with properties of associated co-efficients)" by C. Krishnamachari, 133-146; "Short notes: Linear systems of the third order on a conic" by R. Vaidyanathaswami, 147-150; Questions and Solutions, 151-160.

MATHEMATICAL GAZETTE, volume 10, December, 1921: "A school course in surveying" by H. R. Vernon, 353-358 ["The field-work and plan-drawing are done during Geography lessons, while the calculation of area, height finding and resection are undertaken by the mathematics classes." For school children of ages 10-13, graded]; "Missing-figure problems" by W. E. H. Berwick, 359-362 [A number of new and interesting problems in "skeleton" addition, multiplication and division. See 1921, 37, 278]; "Sign in elementary analytical geometry" by F. G. Brown,

363-368 ["It is not claimed that the conventions indicated in this brief paper are entirely satisfactory; Bôcher in his *Plane Analytic Geometry* indicates that neither his own convention 'nor any other one which could be made' can be satisfactory. . . . Immediately you try to frame satisfactory rules for the perpendicular from a point to a line you run up against the fundamental convention of Cartesians, which requires (x, y) to be arrived at by travelling from the axes and not towards them."]; "Gleanings far and near," 358, 362, 368 [No. 88. "The American Cocker—'I have heard that devils can be raised with Daboll's arithmetic. . . . That's my small experience as far as the Massachusetts calendar, and Bowditch's navigator, and Daboll's arithmetic go.'—p. 515, Herman Melville's *Moby Dick* (World's Classics)"]; Review of W. F. Osgood's *Elementary Calculus* by C. Jones, 381-382.

MATHEMATICS TEACHER, volume 14, May, 1921: "Why it is impossible to trisect an angle or to construct a regular polygon of 7 or 9 sides by ruler and compasses" by L. E. Dickson, 217-223; "College entrance requirements in mathematics: preliminary report of National Committee on Mathematical Requirements," 224-245; "Comments on the teaching of geometry" by F. C. Touton, 246-251; "Some ideals in teaching mathematics" by E. W. Schreiber, 252-254; "Computation in junior high school mathematics" by D. W. Werremeyer, 255-260; "The slide rule in business" by S. L. Shelley, 261-263; "A program of investigation and coöperative experimentation in the mathematics of the seventh, eighth and ninth school years" by R. Schorling and J. R. Clark, 264-275; "Testing as a means of improving the teaching of high school mathematics" by E. R. Breslich, 267-291; New Publications, 292-295—October: "The aims of mathematical education" by J. H. Minnick, 297-304; "Empirical results in the theory of numbers" by R. D. Carmichael, 305-310; "Teaching pupils how to study mathematics" (to be continued) by A. Davis, 311-320; "*La Disme* of Simon Stevin—The first book on decimals" by Vera Sanford, 321-33; "No homework for mathematics pupils" by H. C. Wright, 334-336; "The future of secondary instruction in geometry" by H. E. Webb, 337-341; "The slide rule as a subject of regular class instruction in mathematics" by W. E. Breckenridge, 342-343; News and Notes, 344-348; Book Reviews, 349-354.

NATURE, volume 108, October 27, 1921: "A system of space-time co-ordinates" by J. L. Synge, 275—November 3: "Psychological tests for vocational guidance," 321-323 [A report of a conference. "Mr. D. Kennedy Fraser (lecturer in education at the University of Edinburgh) spoke upon similar lines. He described from personal experience the use of intelligence tests in America. . . . He strongly urged the execution of similar research in this country"]; "University and educational intelligence," 323-324 ["The Rhodes Trust has issued a statement for the academic year 1920-21 dealing with the scholarships it administers. . . . 129 (Rhodes scholars were in residence) from the United States . . . mathematics had six Rhodes Scholars" (altogether)]—November 17: "Reflection 'Halo' of (semi-) cylindrical surfaces" by J. H. Shaxby, 369; "Problems of physics" by O. W. Richardson, 372-377 ["Abridged from the presidential address delivered to Section A (Mathematics and Physics) of the British Association at Edinburgh on September 9"]; "Notes," 380 ["The Copley Medal (was presented in 1921 by the Royal Society) to Sir Joseph Larmor, for his researches in mathematical physics"]—November 24: "The tendency of elongated bodies to set in the north and south direction" by E. H. Grove-Hills, 403 [A reply to Sir Arthur Shuster. "The whole matter is fully discussed in an article by Mr. W. D. Lambert of the United States Coast and Geodetic Survey in the *American Journal of Science*" (see above)]; "Societies and Academies: Royal Society, November 17," 421 ["The design of repeating patterns" by P. A. MacMahon and W. P. D. MacMahon (Quotation: "The study and classification of repeating patterns in space of two dimensions is founded upon the simplest geometrical forms which happen to be repeats. These are employed as bases and are subjected to specified transformations which depend upon certain contact systems. . . . Repeats are of three varieties, the block, the 'stencil,' and the 'archipelago.'"), "The mathematical foundations of theoretical statistics" by R. A. Fisher]; "Philosophical Society, October 31," 421 ["Convex solids in higher space" by W. Burnside; "The fifth book of Euclid's 'Elements'" by M. J. M. Hill.]

PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, volume 7, March, 1921 (received October 1): "Normalized geometric systems" by A. A. Bennett, 84-89; "Problems of potential theory" by G. C. Evans, 89-98—May: "An overlooked infinite system of groups of order pq^2 " by G. A. Miller, 146-148—June: "A formula for the viscosity of liquids" by H. B. Phillips, 172-177—September: "The average of an analytic functional" by N. Wiener, 253-260; "Semi-covariants of a general system of linear homogeneous differential equations" by E. B. Stouffer, 273-276; "An algorism for differential invariant theory" by O. E. Glenn, 276-279—

October: "The average of an analytic functional and the Brownian movement" by N. Wiener, 294-298; "An integral equation and its applications" by E. Hille, 303-305.

REVUE GÉNÉRALE DES SCIENCES, volume 32, October 15, 1921: "Application des méthodes interférentielles aux mesures astronomiques," 531-532.

SCHOOL SCIENCE AND MATHEMATICS, volume 21, December, 1921: "The value and method of the historical element in the teaching of secondary mathematics" by J. T. Vallandigham, 817-822; "Worth while work with algebra failures" by Helen I. Westley, 822-825; "Teaching proportions in geometry and algebra" by J. A. Nyberg, 868-874; "Note on prime numbers" by G. A. Miller, 874 [Giving a formula proved by Tschebychef, and then a modified form. "The main object of this note is to warn the readers thereof not to adopt the former formula, which appears in various reliable works, including Landau's *Primzahlen*, volume 1, 1909, page 22. The present writer employed this formula several years ago in Miller, Blichfeldt, Dickson *Finite Groups*, 1916, page 167, where the latter formula would have been more useful. Hence this warning is the more earnest especially since the latter is such a direct consequence of the former and the notion of prime number is so very elementary. The note may also serve to illustrate the fact that obvious improvements are sometimes overlooked by the best authors."]

SCIENCE, new series, volume 54, October 7, 1921: "A new graphic analytic method" by R. von Huhn, 334-336—October 28: "The American Mathematical Society" by R. G. D. Richardson, 416—November 11: "A notable mathematical gift" [the subsidy promised to the Mathematical Association of America by Mrs. Mary Hegeler Carus] by G. A. Miller, 456—November 25: "The eclipse expeditions to Christmas Island," 513 ["It is hoped to confirm the results obtained by the British expeditions at Principe and Sobral during the eclipse of May, 1919"]; Review by C. J. Keyser of B. Russell's *The Analysis of Mind* (New York, 1921), 518-520.

SCIENCE PROGRESS, volume 16, October, 1921: "Recent advances in pure mathematics" by Dorothy M. Wrinch, 173-178; Review by G. B. J. of H. S. Carslaw's *Introduction to the Theory of Fourier's Series and Integrals* (London, 1921), 324.

SCIENTIFIC MONTHLY, volume 14, January, 1922: "Certain unities in science" by R. D. Carmichael, 41-59; "Thomas Hariot—1560-1621" by F. V. Morley, 60-66.

SIGMA XI QUARTERLY, volume 9, September, 1921: "What should the Society of Sigma Xi preach?" by G. A. Miller, 64-66.

SPHINX-ÉDIPE, volume 16, September, 1921: "Notice sur Charles Ange Laisant" (suite) by H. Brocard, 129-133; "Conférences Math. à Bruxelles (1920-1921)," 133-134; "Tables de M. Kraitshik," 135; "Questions et Réponses," 135-143; "Histoire de Sciences" [account of an early French periodical, *Le Géomètre*, see below], 143-144; "Divers: Télescope géant," 144—October: "Arithmetic of potentials" by T. J. Barniville, 145-147; "Sur les racines primitives relatives au mod. P^n dans un corps algébrique quelconque" by G. Métrod, 147-150; "Construction d'une polygraphie de cavalier avec Sphinx en partant d'un circuit complet et fermé" (suite et fin.) by "Un Abonné," 150-154; "Sur l'équation $(1) x^4 + ax^2y^2 + y^4 = z^2$, a positif" by M. Rignaux, 154-155; "Questions et Réponses," 156-160; "Divers: Astronomie," 160 [L'astronome américain Pickering vient de faire des observations, qui, d'après lui, prouveraient que la vie existe à la surface lunaire.]"

["Le Géomètre" était un Recueil de mathématiques, à l'usage des candidats aux Ecoles Royales Polytechnique, de St. Cyr, de la Marine des Eaux et Forêts, etc. publié par M. GUILLARD, ancien élève de l'Ec. Normale, Agrégé de l'Université, Prof. de Math. Elém. au Collège Royal de Louis le Grand, Paris, chez l'éditeur Rue St. Jacques N° 121 à partir du 15 Mars 1836. Ce volume de 224 pp. (13 x 21) et 9 pl., était composé chez Ch. Eberhart, imprimeur du Collège R. de France, 12 Rue du Foin St. Jacques, et l'on y trouve la liste de 245 souscripteurs, dont certains se sont fait un nom, depuis cette époque: GERONO, ex-principal du Collège de Lorient; STURM, prof. au Collège Rollin; le baron REYNAUD, examinateur; MIQUEL, élève de l'Institution Barbet; CATALAN, régent de Math. au Collège de Châlons-sur-Marne; Le FEBURE de FOURCY, examinateur; TERQUEM, bibliothécaire du dépôt central d'artillerie; CHASLES anc. élève de l'Éc. Polyt., à Chartres;

"Ce journal, dont nous avons ainsi les 14 premières feuilles parues donnait des mémoires, des questions et des réponses. Je signalerai les solutions de CHAUWIN (conc. général math. élém. 1822), VANÉECHOUD (conc. général de 1809, prem. et 2° classes de math. des lycées de Paris), BRUYÈRE (conc. de 1817, Elém.), GIORGINI (1812, Spéc.), GERONO (1818, Elém.), LATOUR et de PRIVEZAC (concours de 1814, Spéciales). . . .

"A signaler aussi: un théorème remarquable de MIQUEL (p. 166) et la Quest. 3 (p. 14, rép. p. 164-166): *Diviser un triangle scalène en quatre parties égales, par 2 lignes qui se coupent à angles droits*. Cette question a été reprise en 1894 dans l'*Interm. des Math.*"

["TÉLESCOPE GÉANT: M. MACAFEE, bien connu aux U. S. A. pour ses travaux astron., en collab. avec le Prof. DAVID TODD, de Harvard s'occupe actuellement en France d'établir les plans du plus gigantesque télescope connu. On verra Mars aussi aisément que si l'on n'était qu'à 2 km. 500 de distance.—Pour obvier aux difficultés que présente la construction d'un colossal miroir réflecteur, M. MacAfee remplace celui-ci par une cuvette de métal de 50 pieds de diamètre, remplie de mercure; un mouvement rotatif imprimé à cette cuvette lui donne la concavité voulue, et lui fait jouer l'office de réflecteur. On annonce la livraison pour 1924."]

UNDERGRADUATE MATHEMATICS CLUBS.

All reports of club activities should be sent to E. L. DODD, 3012 West Ave., Austin, Texas.

CLUB ACTIVITIES.

THE MATHEMATICS CLUB OF BROWN UNIVERSITY, Providence, R. I.

[1918, 33; 1919, 167; 1920, 28, 223.]

The officers for the session 1921-1922 are the following: Chairman, Professor R. G. D. Richardson; Committee on program, Professor Burgess, Professor Gilman, Frances Merriam, Gr., Elizabeth Stafford '23, Charles Hopkins '22, George Sauté '24; Committee on arrangements, Mr. C. D. Wentworth, instructor, Nellie Stokes '23, Frances Wright '23, Clarence Eddy '22, Phillip Welch '23.

In a printed program, the following papers are announced:

October 27, 1921: "The story of a mathematical book" by Professor D. E. Smith, of Columbia University.

December 9: "Lewis Carroll" by Dorothy Rickenbacker '23; "Number systems on other bases than ten" by Clarence Bennett '23; "Various proofs of the Theorem of Pythagoras" by George Sauté '24.

January 13, 1922: "Mathematics of the calendar" by Henry Bodwell '24; "The three point problem" by Frances Merriam, Gr.

February 17: "Skeleton division" by Clarence Eddy '22; "Cardan and the solution of the cubic" by Elizabeth Stafford '23; "The inscribed regular heptagon" by Frances Wright '23.

March 10: "Some special graphical methods" by Professor O. D. Kellogg, of Harvard University.

April 28: "Cryptography" by Donald MacPherson, Gr.; "Galois" by Katherine Colton '22; "Measuring the diameter of Betelgeuse" by Charles Hopkins '22.

May: Picnic.

MATHEMATICS CLUB OF COLUMBIA UNIVERSITY, New York.

[1918, 227; 1919, 262; 1920, 425.]

The following officers were elected for the year 1920-21: President, Albert Meder, Jr. '22; vice-president, Oscar Bodansky '22; secretary, William Thompson '23. The following papers were read:

October 1, 1920: "Some graphical methods" by Albert Meder, Jr. '22.

October 15: "Mathematical bits from Leacock" by Oscar Bodansky '22.

October 29: "Formulae of investments" by Professor L. P. Siceloff.

November 12: "The probability equation" by A. Preisman '22.

November 26: "Constructibility" by O. Frink, Jr. '22.

December 10: "Analytic methods" by R. Kronig '22.

January 12, 1921: "Relations" by Professor C. J. Keyser.

February 18: "Volumes and areas with empirical boundaries" by W. Skeats '23.

March 4: "Convergent series" by Professor W. B. Fite.

March 18: "Measuring Betelgeuse" by M. Schwartzschild '22.

April 8: "Discontinuous functions" by Professor T. S. Fiske.